

Thermal and Mechanical Optimization of Structural Thermal Insulation Composites

Completed Technology Project (2012 - 2016)



Project Introduction

Space exploration and lunar habitation is currently limited by factors such as the extreme lunar environment and costs of shipping. Materials are needed that are lightweight and can withstand large temperature fluctuations, impact, and radiation. The structural thermal insulation composites developed by this project will provide a lightweight, low-cost solution to the problem and also adapt well for uses on earth. The technology is anticipated to increase sustainable construction options in commercial/residential insulation and marine applications. The overall goal of the proposed work is to develop composites using advanced materials which will provide a thermal conductivity and an in-plane tensile strength suitable for use in constructing habitats and other structures for extreme temperature environments as well as sustainable commercial/residential construction. The scope of this project will be to investigate the properties of constituent materials as well as optimize the layering sequences of these materials in their final structural form. The approaches taken to complete this research are organized into four tasks: Constituent material characterization Modeling thermal and mechanical properties Fabrication of composite specimens Thermal and mechanical testing of composites This research is anticipated to provide NASA and the space industry with a superior composite structural insulation system for lunar habitations and space exploration in other extreme temperature environments. This research applies to the OCTs Technology Areas 12 and 14 because it will develop lightweight, special materials to incorporate into structural insulation composites for use in multi-functional structures. The research will also address heat transfer through structural insulation composites and create a solution for extreme temperature environments. These composites will progress space technology toward lightweight, low-cost, insulating materials for use in habitats, multi-functional structures, and other space exploration.

Anticipated Benefits

This research applies to the OCTs Technology Areas 12 and 14 because it will develop lightweight, special materials to incorporate into structural insulation composites for use in multi-functional structures. The research will also address heat transfer through structural insulation composites and create a solution for extreme temperature environments. These composites will progress space technology toward lightweight, low-cost, insulating materials for use in habitats, multi-functional structures, and other space exploration.



Project Image Thermal and Mechanical Optimization of Structural Thermal Insulation Composites

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Responsible Program:

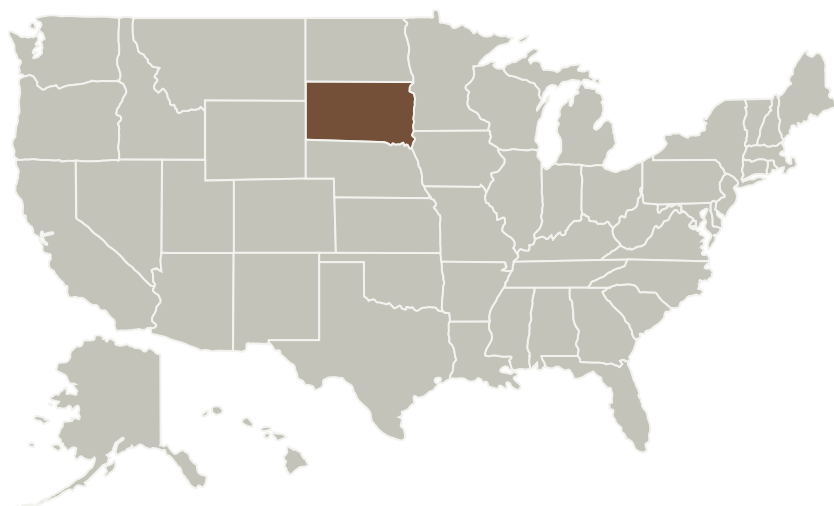
Space Technology Research Grants

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
South Dakota School of Mines and Technology	Supporting Organization	Academia	Rapid City, South Dakota

Primary U.S. Work Locations

South Dakota

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

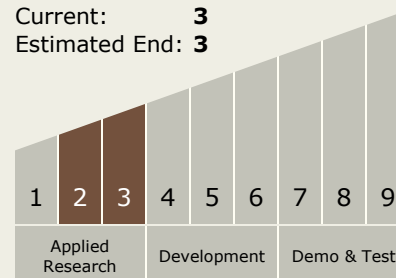
Marc Robinson

Co-Investigator:

Anthony T Kulesa

Technology Maturity (TRL)

Start: 2
Current: 3
Estimated End: 3



Technology Areas

Primary:

- TX14 Thermal Management Systems
 - TX14.3 Thermal Protection Components and Systems
 - TX14.3.1 Thermal Protection Materials

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Images



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Project Image Thermal and
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(<https://techport.nasa.gov/image/1835>)

Project Website:

<https://www.nasa.gov/directorates/spacetech/home/index.html>